

Bereskin & Parr

INTELLECTUAL PROPERTY LAW



Appl. No. : 09/621,234 Confirmation No.: 3325
Applicant : HENSHAW et al.
Filed : July 20, 2000
Title : VERTICAL CYLINDRICAL SKEIN OF HOLLOW FIBER
MEMBRANES AND METHOD OF MAINTAINING CLEAN FIBER
SURFACES
TC./A.U. : 1723
Examiner : FORTUNA, Ana M.
Docket No. : 4320-241
Customer No. : 001059

Board of Patent Appeals and Interferences
United States Patent and Trademark Office
P. O. Box 1450
Alexandria, Virginia 22313-1450

March 31, 2006

BRIEF IN SUPPORT OF APPEAL

Real Party in Interest

The Real Party in Interest in the present Appeal is Zenon Environmental Inc., the assignee, as evidenced by the assignment set forth at Reel 8135, Frame 0355.

Related Appeals and Interferences

Appeals are pending in Application Serial Nos. 11/049,988 and 11/059,403. These applications claim priority from Application Serial No. 08/690,045 which issued as Patent No. 5,783,083. The present application seeks to reissue Patent No. 5,783,083. To date, there have been no decisions in these appeals.

Status of Claims

The present application had 23 claims, claims 1-14 being the same as those issued in U.S. Patent No. 5,783,083. Currently, claims 1-18 and 23 are pending. Claims 19-22 have been cancelled. Claims 1-14 are allowed. Claims 15-18 and 23 are rejected and the subject of this appeal. A copy of the appealed claims appears in the Claims

Appendix.

04/04/2006 JADD01 00000041 09621234

01 FC:1251

120.00 OP

04/04/2006 JADD01 00000041 09621234

02 FC:1402

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Status of Amendments

No amendments have been filed after the final rejection of October 4, 2005.

Summary of the Claimed Subject Matter

All references in the following paragraphs apply to either the application as filed or to Patent No. 5,783,083, a copy of which is attached in the Evidence Appendix.

The appealed claims relate to a hollow fiber membrane filtration system used to filter or separate a permeate from a liquid substrate having particulate matter therein (column 5, line 58 to column 6, line 6). An example of such a system is shown in Figures 11 and 12 and described at column 17, line 24 to column 18, line 7. In particular, the system has a non-pressurized reservoir 90 for containing the substrate. An assembly 81 having a plurality of hollow fiber membranes is immersed in the substrate. A pump (column 17, lines 62-66) applies a suction to the lumens of the hollow fiber membranes to draw a component of the substrate (the permeate) through the membranes while leaving particulate matter in the substrate (column 17, lines 51-54). An aeration means discharges air into the substrate to provide a column of bubbles rising from near lower ends of the membranes (Column 8, lines 61-63). The membrane assembly is shown in more detail in, for example, Figure 2. The assembly has a plurality of hollow fiber membranes 12, which may be called either "membranes" or "fibers" for brevity, disposed generally vertically between upper and lower solid bodies 23, 24. Lumens of the membranes communicate with a permeate collection means 21 which in turn may be connected through pipes 31 and 30 to a pump. In this way, suction generated by the pump creates a partial vacuum inside the lumens of the membranes that draws permeate through the membranes.

The membranes are sealingly secured in the solid bodies so as to prevent solids in the substrate from contaminating the permeate (column 7, lines 35-40). The solid bodies are comprised of a potting material, and at least a portion of the membranes are spaced apart by the potting material to a center to center distance in the range of 1.2 to 5 times the outside diameter of the membranes (column 7, lines 28-31). With such a spacing,

the membranes do not touch each other but rather are spaced apart by the potting material between them (Column 11, lines 43-47).

Grounds of Rejection to be Reviewed on Appeal

This is a broadening reissue application filed within two years of the issue date of the patent being reissued. Claims 15-18 and 23 were rejected for allegedly recapturing matter surrendered in the original application for patent and thereby not correcting an error within the meaning of 35 USC 251.

The Examiner's rationale is that claims 1 and 9 in 08/690,045, now US 5,783,083 both have the following provision:

each said header having said fibers spaced apart by a flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers, said support means extending over only each terminal portion of said fibers near their ends, so as to maintain said ends in closely-spaced apart relationship.

The provision was added in an amendment filed January 12, 1998, a copy of which is attached in the Evidence Appendix. This amendment resulted in allowance of the application. The Examiner submits, therefore, that the Applicants surrendered any coverage broader than the provision above. Since claims 15-18 and 23 in this reissue lack that provision, the Examiner submits that these claims should be rejected under 35 USC 251 as involving an improper attempt to recapture surrendered subject matter.

Argument

MPEP 1412.02 I refers to a three step test for recapture. While the Applicants disagree with at least some of the statements regarding the third step in the MPEP, for the purpose of this appeal, the Applicants will structure their arguments to follow the three step test.

The first step in the test for recapture involves determining whether and in what aspect the reissue claims are broader than the claims of the patent being reissued. In this case, the Examiner has identified a limitation that has been deleted from claims 1 and 9 of Patent No. 5,783,083. This limitation relates to the spacing of the membranes, or fibers, and is repeated again for convenience below:

each said header having said fibers spaced apart by a flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers, said support means extending over only each terminal portion of said fibers near their ends, so as to maintain said ends in closely-spaced apart relationship.

The Applicants acknowledge that the words above do not appear verbatim in claims 15-18 and 23 under appeal. However, a limitation related to fiber spacing does appear in claims 15-18 and 23 as reproduced below:

at least a portion of the membranes spaced apart from adjacent membranes by the potting material to a center to center distance in the range from 1.2 to 5 times the outside diameter of the membranes

The Applicants acknowledge that the limitation in claims 15-18 and 23 is broader in some respects than the limitation in claims 1-9 of patent No. 5,783,083 although it is also the same as or narrower in other respects

The next step in considering a recapture rejection is to determine whether the reissue claims' broader aspect relates to surrendered subject matter. For the purposes of this appeal, the Applicants do not contest that the reissue claims' broader aspect relates to an area of surrendered subject matter, namely fiber spacing.

The third step in considering a reissue application is to determine whether surrendered subject matter has crept into a reissue claim. This is done by comparing the reissue claim with the claims cancelled (or constructively cancelled by making a narrowing amendment) to secure allowance. The wording of the cancelled claims is apparent from the Amendment of January 12, 1998 in the Evidence Appendix. The Applicants submit that the claim cancelled to secure the allowance of Claims 1 and 9 of Patent No. 5,783,083 did not include any part of the limitation identified by the Examiner. Thus, the relevant limitation of the cancelled claims, the claims of Patent No. 5,783,083 and claims 15-18 and 23 of the present application are as follows:

Cancelled Claims:

No limitations regarding fiber spacing

Claims 1 and 9 of Patent No. 5,783,083:

each said header having said fibers spaced apart by a flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers, said support means extending over only each terminal portion of said fibers near their ends, so as to maintain said ends in closely-spaced apart relationship

Application Claims 15-18 and 23:

at least a portion of the membranes spaced apart from adjacent membranes by the potting material to a center to center distance in the range from 1.2 to 5 times the outside diameter of the membranes

The Applicants submit that the claims of the present application are not as broad or broader than the canceled claims. Further, the claims of the present application are narrower than the claims of U.S. Patent No. 5,783,083 in that they specify a numerical range for the spacing of the membranes. Accordingly, the Applicants submit that the application claims do not constitute recapture and are allowable. "Some reissue claims, however, are broader than the canceled claim

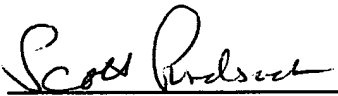
in some aspects, but narrower in others...If the reissue claim is narrower in an aspect germane to prior art rejection, and broader in an aspect unrelated to the rejection, the recapture rule does not bar the claim." *In re Clement*, 45 USPQ 2D 1161 at 1165. The Applicants further submit that claims 15-18 and 23 at least contain a broadened form of the limitation added to secure allowance of patent No. 5,783,083. Thus, claims 15-18 and 23 present no recapture pursuant to MPEP 1412.02 IC2(d) and *Ex Parte Eggert*, 67 USPQ 2d 1716 (*Bd.Pat.App.Inter.2003*), see for example page 1717 left column and first three lines of the right column.

Summary

For the foregoing reasons, the Appellants believe that the Examiner's rejections of claims 15-18 and 23 are erroneous and respectfully request reversal of those rejections.

Respectfully submitted,

HENSHAW et al.

By 

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CLAIMS APPENDIX

15. (Previously Presented) A system for withdrawing permeate from a liquid substrate while leaving particulate matter therein, comprising,

- (a) a non-pressurized reservoir other than a shell of a module for containing the substrate;
- (b) an assembly having a plurality of hollow fiber filtering membranes immersed in the substrate each membrane having a length greater than 0.5 m, the membranes together providing a surface area of at least greater than 1 m² and disposed generally vertically between upper and lower generally cylindrical solid bodies comprised of a potting material with (i) the solid bodies having the membranes sealingly secured therein so as to prevent the substrate from contaminating the permeate, at least a portion of the membranes spaced apart from adjacent membranes by the potting material to a center to center distance in the range from 1.2 to 5 times the outside diameter of the membranes, (ii) lumens of said membranes being in fluid communication with at least a permeate collection means connected to one of the solid bodies and immersible in the substrate or to a pair of permeate collection means connected one to each of the solid bodies and both immersible in the substrate, and, (iii) said membranes having a length between opposed surfaces of the solid bodies, in the range from 0.1% to 5% greater than the distance between opposed surfaces of the solid bodies;
- (c) a pump in fluid communication with said lumens of said membranes through at least one permeate collection means, said pump operable to apply a suction to the lumens of the membranes to draw a component of the substrate as permeate through said membranes while leaving particulate matter in said substrate; and,

(d) aeration means having through-passages with openings, distributed both radially and circumferentially between the membranes for discharging air directly into the substrate near the lower solid body to provide a column of bubbles rising from near lower ends of the membranes.

16. (Previously Presented) The system of claim 15 wherein the length is in the range from 0.1% to 1% greater than the distance between the opposed surfaces of the solid bodies.

17. (Previously Presented) The system of claim 16 wherein the aeration means includes a rigid air supply tube for carrying air to the through-passages and for spacing and positioning the lower and upper solid bodies relative to one another.

18. (Previously Presented) The system of claim 17 wherein the air supply tube has additional through-passages along its length.

23. (Previously Presented) The system of claim 15 wherein the aeration means comprises an air blower and a passageway between the air blower and the openings is sealed so as to prevent the substrate from entering the passageway other than through the openings.

EVIDENCE APPENDIX

1. U.S. Patent No. 5,783,083
2. Amendment dated January 12, 1998 in Application Serial No. 08/690,045



1/1
1-28-92K

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOX: AMENDMENT (PATENTS) 1/28/98

Applicants: Mahendran, Mailvaganam; Henshaw, Wayne J. et al.
Application's Title: VERTICAL CYLINDRICAL SKEIN OF HOLLOW FIBER etc.
Serial No.: 08/690,045
Filed: July 31, 1996
Group Art Unit: 3106
Docket No.: ZEN-9501-A

Examiner: ANA FORTUNA

January 8, 1998

AMENDMENT

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231.

Sir:

This is in response to the office action mailed 10 September 1997. Please amend the above-identified patent application as follows:

IN THE SPECIFICATION:

page 1, line 6, after "1995" insert now issued as U.S. Patent No. 5,639,273.

IN THE CLAIMS:

Cancel claims 15 - 19 drawn to a method of making a header of hollow fibers classified in class 264, subclass Dig. 48, without prejudice, these claims having been withdrawn as a result of an election between Groups in a requirement for restriction.

- A1 1. (Amended) In a gas-scrubbed assembly comprising, a microfiltration membrane device in combination with a gas-distribution means to minimize build-up of particulate deposits on the surfaces of hollow fiber membranes ("fibers") in said device, and to recover permeate from a multicomponent liquid substrate while leaving particulate matter therein, said membrane device comprising,

a multiplicity of fibers, unconfined in a shell of a module, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi);

a first and second header disposed in transversely spaced-apart relationship within said substrate, each header being formed with a potting resin cured in a resin-confining means;

said first header and second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate collection means to collect said permeate through at least one of said headers sealingly connected in open fluid communication with permeate-discharging faces of said headers;

means for withdrawing said permeate; and,

AI cont
said gas-distribution means is located within a zone beneath said skein, said gas-distribution means having through-passages therein adapted to have sufficient gas flowed therethrough to generate enough bubbles flowing in a column of rising bubbles between and around said skein fibers, to keep surfaces of said fibers awash in bubbles;

[the improvement comprising,]

said fibers, said headers and said permeate collection means together forming a vertical cylindrical skein wherein said fibers are essentially vertically disposed; said first header being upper and disposed in vertically spaced-apart relationship above said second header with opposed faces of said headers at a fixed distance, said fibers being substantially concentrically disposed relative to the vertical axis between said headers;

each of said fibers having substantially the same length, said length being from at least 0.1% greater, to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber; [and,]

the improvement comprising,

each said header having said fibers spaced apart by a flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers, said support means extending over only each terminal portion of said fibers near their ends, so as to maintain said ends in closely-spaced apart relationship,

said gas distribution means being disposed between said fibers and having through-passages adapted to discharge said bubbles which rise vertically substantially parallel to, and in contact with said fibers, movement of which is restricted within said column;

whereby said permeate is essentially continuously withdrawn [while concentration of said particulate matter in said substrate is increased].

9. (Amended) In a microfiltration membrane device, for withdrawing permeate essentially continuously from a multicomponent liquid substrate [while increasing the concentration of particulate material therein], said membrane device including: a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers being swayable in said substrate, said fibers being subject to a trans-membrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi);
- a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;
- said first header having a terminal end portion of each fiber secured therein, and said second header having an opposed terminal end portion of each fiber secured therein, all said fibers extending from a permeate-discharging face of at least one said header; said fibers being sealingly secured with open ends of the fibers secured in fluid-tight relationship with each other in at least one of said headers;
- permeate collection means to collect said permeate through at least one of said headers sealingly connected in open fluid communication with permeate-discharging faces of said headers;
- and, means for withdrawing said permeate;
- [the improvement comprising,]

said fibers, said headers and said permeate collection means together forming a vertical cylindrical skein wherein said fibers are essentially vertically disposed; said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance; each of said fibers having substantially the same length, said length being from 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber;

the improvement comprising,

each said header having said fibers spaced apart by a flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers, said support means extending over only each terminal portion of said fibers near their ends, so as to maintain said ends in closely-spaced apart relationship.

13. (Amended) In a process for maintaining the outer surfaces of hollow fiber membranes essentially free from a build-up of deposits of particulate material while separating a permeate from a multicomponent liquid substrate in a reservoir, said process comprising,
 submerging skein fibers in an essentially vertical, cylindrical configuration within said substrate said fibers being unconfined in a modular shell, [said fibers being] and securely held in [laterally] vertically opposed, [spaced-apart first and second] upper and lower headers spaced-apart at a fixed distance, said fibers having substantially the same length and from at least 0.1% greater, to about 5% greater than said fixed distance, a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and a length sufficiently greater than the direct distance between opposed faces of said first and second headers, so as to present said skein in a swayable configuration above a horizontal plane through the horizontal center-line of [a] said lower header;
 mounting said headers in fluid-tight open communication with collection means to collect said permeate;

flowing a fiber-cleansing gas through a gas-distribution means proximately disposed relative to said skein, within a zone beneath said skein, and contacting surfaces of said fibers with sufficient physical impact of bubbles of said gas to maintain essentially the entire length of each fiber in said skein awash with bubbles and essentially free from said build-up;
 maintaining an essentially constant flux through said fibers substantially the same as an equilibrium flux initially obtained after commencing operation of said process;
 collecting said permeate in said collection means; and,
 withdrawing said permeate,
 the improvement comprising,
 [deploying said skein fibers within said column in an essentially vertical, cylindrical configuration, with said headers in fixed spaced apart relationship at a fixed distance, said skein having fibers of substantially the same length and from at least 0.1% greater, to about 5% greater than said fixed distance, said fibers being independently swayable from side-to-side within a vertical zone of movement;]
 introducing said cleansing gas between said fibers within said skein to generate a column of said bubbles alongside and in contact with outer surfaces of said fibers;
 restricting movement of said fibers to said vertical zone defined by lateral movement of outer fibers in said skein;
 vertically gas-scrubbing said fibers' outside surfaces with bubbles which flow upward in contact with said surfaces;
 maintaining said surfaces substantially free from said deposits of particulate matter during a period when flux through said fibers has attained equilibrium; and,
 simultaneously, essentially continuously, withdrawing said permeate [while increasing the concentration of said particulate material in said substrate].

A3 end

REMARKS

The provisional election of claims in Group I, namely claims 1-12 and 13-14 is affirmed.

The non-statutory double patenting rejection based on a judicially created

doctrine, is respectfully traversed. It is respectfully submitted that the terminal disclaimer filed herewith overcomes the rejection of record.

Each of the independent claims 1, 9 and 13 has been amended in view of the Japanese Patent Application No. Sho 61 [1986] - 292045 of inventor Tamiro Kunio which was cited by an European examiner. The reference discloses a skein having fibers which are deliberately longer than in a conventional skein, as are the fibers in applicants' invention. Such a skein with fibers longer than in a conventional skein is referred to herein as an "extended skein".

Kunio states "Conventionally, it (the degree of excess length) has been set with excess length of approximately 5 percent." (see sentence bridging pages 3 and 4, pagination numerals appear at the bottom of the pages) indicating that, in Japan, it was conventional to set the excess length of fibers in a vertical skein at about 5%. Kunio discovered that if the excess length was set for 1% to 4%, an extended vertical skein can withstand the rigors of backwashing much better than with other excess lengths either less than 1% or greater than 4%. The conventional system described by Kunio is a deadend filtration system, and since in such a system there is no provision for aerating a skein while filtering the substrate, neither Kunio nor others in Japan who used such a conventional system could have aerated their skeins during filtration.

As stated by Kunio "However, situations in which the multiple pieces of hollow yarn 2a become twisted then bent and damage (*sic*) have occurred as filtration and backwashing were repeated." (see lines 1 -3, top of page 3) indicating that each separate cycle of filtration and backwashing resulted in some damage. This is not surprising since backwashing is carried out with pressurized air blown **through the lumens** (longitudinal axial bores) of the fibers to dislodge deposits from the surfaces of the fibers, and simultaneously air is also blown around the outer surfaces of those fibers to make sure the dislodged deposits do not accumulate in the bundled fibers of the Kunio skein. Aeration of the outer surfaces is referred to by Kunio as a "bubbling operation" (see page 3, line 7 of the full paragraph in the middle of the page). However, even with 1% "slack", Kunio observed some damage with each backwashing cycle as graphically illustrated in his Fig 3. Such damage is unacceptable in a

commercially operated skein. In his Declaration under 37 C.F.R. 1.132, appended hereto, Steven Pedersen states "In a commercial installation, if backwashing damages only one (1) fiber out of one thousand (1000) fibers in a skein, the backwashing would be deemed unsatisfactory." (see numbered paragraph 10).

Applicants discovered that if the fibers in an extended skein were not bundled, but potted in spaced-apart relationship, spaced apart by a flexible support means, there was no damage to the fibers over an extended period. Applicants discovered that with spaced-apart fibers in headers of an extended skein, in which skein the specified "slack" may be in a range wider than the range Kunio required for survival of his skein during backwashing, skein fibers will be immune to the damage suffered by Kunio's skein fibers, provided the ends of the fibers were potted in spaced-apart relationship in a header which was not rigid. As explained herebelow, there is **no provision in Kunio** for aerating his skeins during filtration, and it is clear he never intended to do so. It is self-evident (and affirmed by Kenneth Goodboy in his appended Declaration under 37 C.F.R. 1.132, numbered paragraph 8) that if the equipment Kunio used was incapable of disposing of air used for aerating the skein while filtering, Kunio could not suggest aerating the skein **while filtering**.

Accordingly, claim 9 has been amended to specify the first essential limitation ("slack") in the preamble, and to define the second essential element. This second essential element is the "flexible support means having a thickness corresponding to a desired lateral spacing between adjacent fibers" in the headers. Claim 1 is directed to the skein of amended claim 9 in combination with gas distribution (typically, aeration) means. Claim 13 is specifically directed to vertically gas-scrubbing the biers' outer surfaces while maintaining "clean" fibers and **simultaneously filtering** the substrate.

Enclosed herewith is the Japanese text of the Japanese Patent Application; also enclosed is a certified translation of the Japanese text.

Referring to the "Conventional Art" Kunio states:

In the aforesaid configuration, when the differential pressure before and after the hollow yarn membrane filter 2 rises due to filtra-

tion and reaches a specified value, *a backwash operation is executed to perform an operation to wash off the solid portion which has adhered to the surfaces of the respective pieces of hollow yarn 2a. That is, a pressurized gas for backwashing is supplied inside the respective pieces of hollow yarn 2a of the hollow yarn membrane filter 2 via the aforesaid processing fluid discharge pipe 11. Simultaneously, a bubbling operation is executed from below the hollow yarn membrane filter 2. That is, a bubbling pipe 15 is arranged below the hollow yarn membrane filter 2 within the aforesaid container main unit 1, and bubble holes 16 are formed in the lower surface of this bubbling pipe 15. The aforesaid bubbling pipe 15 is connected to an air supply pipe 17 which has a shut-off valve 18. By supplying air to the aforesaid bubbling pipe 15 via the aforesaid air supply pipe 17, bubbles are generated from the aforesaid bubble holes 16. The hollow yarn membrane filter 2 is subject to bubbling by the aforesaid bubbles to improve the washing effect. An overflow pipe 19 is connected to the container main unit 1 so that it is positioned below the aforesaid diaphragm 3, and a shut-off valve 20 is positioned along said overflow pipe 19. Callout 21 in the diagram is a protecting tube, and this protecting tube 21 which allows the bubbles from the aforesaid bubbling to be effectively introduced into the hollow yarn membrane filter 2. (see middle of page 3, numbered at the bottom; italics supplied).*

Kunio goes on to describe what happens in conventional membrane filters when they are backwashed, and that the source of the **problems in backwashing** is due to the

"question of what degree of excess length should be set for the length (L1; a value larger than L2, since there is some looseness in the gap which is the aforesaid L2) of the hollow yarn 2a arranged between the two ends with respect to the distance . . . in order to effectively perform the aforesaid bubbling and prevent damage to the hollow yarn 2a has not been taken into account." (see bottom of page 3).

Kunio then states that "multiple pieces of hollow yarn 2a become twisted then bent and damage have (*sic*) occurred as filtration and backwashing were repeated." (see top of page 4), and offers the reason for such damage:

"This is thought to be because the hollow yarn 2a consists of a polymer-

ic material, and its specific gravity is almost equal to that of water, which is the main constituent of the processed fluid, so the hollow yarn 2a whirls up, then bends and becomes damaged." (see lines 3-6, page 4).

Finally Kunio offers a solution to the breakage problem during backwashing, namely, that "the excess length, which has been set to approximately 5 percent as mentioned above, may be shortened or eliminated." Kunio then states that the offered solution is not effective because "the following problems occur when such a method is adopted." (see middle of page 4). He then goes on to list the problems of the conventional backwashing which he has described, numbering them 1 through 3. These problems may be summarized as follows:

- 1) greater restriction of excess length provides an insufficient bubbling effect;
- 2) in a dense bundle, flow to the fibers in the interior of the bundle is blocked;
- 3) solid material dropped off accumulates in the bundle.

Kunio reiterates the problem he has already addressed in the earlier portion of his specification, to emphasize it. He now puts it under the heading: "Problems To Be Solved By the Invention". Simply stated, his invention is designed to take into account how to determine excess length, the objective being "to provide a membrane filter which makes it possible to perform effective backwashing while preventing damage to the hollow yarn." (see lower portion of page 4).

Under the heading "Configuration of the Invention" Kunio lists the following subheadings: "Means To Solve Problems"; "Action"; "Embodiments"; and "Benefits of the Invention".

Under "Means To Solve Problems" Kunio states that he uses fibers which satisfy the following criterion:

$$0.01 \leq (\Delta L/L1) \leq 0.04$$

where, L1 represents the length of the hollow yarn arranged between the two bonding agent filling sections; L2 represents the gap between the two bonding agent filling sections; and, $\Delta L = (L1 - L2)$

Under "Action" Kunio states that setting the excess length according to the foregoing criterion effectively solves such problems as (a) the drop in the backwashing effect which occurs due to the excess length being too small, and (b) the bending

and damage which result from the twisting of the hollow yarn which occurs due to the excess length being too great. (see middle of page 7).

Under "Embodiments" Kunio describes the vertical skein which he conventionally potted in two "bonding agent filling sections 6 secured with bundle securing members 7" (see lines 3-4 of page 3). Clearly the fibers are conventionally bundled and potted "by bundling many pieces of the hollow yarn and hardening both ends with resin, which is a bonding agent." (see first paragraph under "Conventional Art" on page 2). The bundle of fibers is secured by "a bundle securing member [which] is installed and secured at the outer circumference of the bonding agent filling sections filled with the aforesaid bonding agent, . . ." (see page 2, lines 1 and 2). In greater detail, Kunio describes how the bundle of fibers is held, as follows: "The aforesaid hollow yarn membrane filter 2 has a structure whereby multiple pieces of hollow yarn 2a are bundled at the outer circumference of a support member 4, and their upper and lower ends are secured by bonding agent filling sections 6, and, in addition, bundle securing members 7 are installed and secured from the outer circumferences thereof." (see sentence bridging bottom of page 2 and top of page 3 and Fig 1 identifying the cylindrical bundle securing ring 7). Such a method allows one to form a bundle with the maximum number of fibers within a cylindrical header, thus providing maximum filtration area for the number of fibers used in the bundle. However, the problem with conventional "bundling" is that too many fibers are in contact with one another with varying degrees of 'tightness', more specifically, fluid-tightness. The result is that when the bundle of fibers is potted, resin impregnates the bundle in direct proportion with the degree of fluid-tight contact between contiguous fibers. Where no resin is cured between fibers there is a likelihood that there will be fiber-to-fiber abrasion, and since the fibers are compressed (the walls of fibers are compressible), that the header holding the bundle will leak. The proclivity to leak is exacerbated when the fibers are of polymer and therefore radially compressible. In operation, these fibers which are contiguously bundled (touching each other in the bundle), chafe against each other as they sway. Such chafing simultaneously weakens the walls of the fibers and increases the likelihood of leakage of substrate between

them, the substrate getting into the permeate collection system. Note that Kunio states:

"2) When the hollow yarn membrane filter 2 is bundled in the aforesaid way in a condition in which multiple pieces of hollow yarn 2a are densely arranged, . . ." (see page 4, lines 12-13)

Applicants discovered how to solve the problem **by avoiding bundling** the fibers in contact with one and another. They sacrificed density of fibers to obtain better longevity (no fiber-to-fiber abrasion) and a leak-proof header. They did so by supporting spaced-apart fibers on a flexible support of desired thickness before potting the fibers, thus assuring a chosen spacing (specified by the center-to-center dimensions) between fibers in the header, and assuring the penetration of resin between every fiber. This additional limitation has been introduced into the amended article claims to the skein.

In a typical laboratory experiment, run over only as long (or short) a period as is required to provide data sought, the leakage of a header is not easily discovered unless one checks for permeate quality. In a commercially used membrane filter which is run over a long period, permeate quality is typically checked continually. Leakage of substrate through a header is a problem of the greatest concern because it results in contaminated permeate, the expenditure of great effort to discover just where the leak(s) has occurred, and quickly "trashing" a suspected skein. It is therefore of over-riding importance that the fibers in a skein be sealed in spaced apart relationship to one another, and applicants discovered how to do this.

There is no argument that Kunio discovered that there was a critical excess length which allowed hollow fibers in a vertical skein to survive the rigors of his **backwashing** process. Applicants discovery of the benefits of the extended skein were directed to a different process - **filtration**. Moreover, Kunio failed to find the leakage problem and therefore never sought a solution to that serious problem.

Since Kunio's data were generated only during backwashing, the excess length (of fibers) he decided was necessary for that operation was in the range from 1% to 4%. Since applicants were only concerned with filtration, not backwashing, the excess

they decided was necessary for filtration was in the range from at least 0.1% greater, to less than 5% greater than the fixed distance between faces of opposed headers. Since the range of 1% to 4% is within the range from 0.1% but less than 5%, the latter range is recited in the preamble of the claims.

Claims 1 - 8, and 9 - 12 (as were claims 13-14), were written in Jepson form, specifically because of applicant's U.S. Patent No. 5,39,373. Claim 9, as amended, recites the excess length as being a conventional aspect of the cylindrical vertical skein, as taught by Kunio, and now specifically identifies the unique relationship of spaced-apart fibers in the headers. The basis for "closely-spaced relationship" is found in the specification at page 12, line 7. The basis for "flexible support means" is found in the specification at page 21, line 8, and in original claim 15 (line 4).

Kunio's only concern was damage during backwashing during which "a pressurized gas for backwashing is supplied inside the . . . hollow yarn . . . Simultaneously, a bubbling operation is executed from below . . . " (see middle of page 3). Obviously, one cannot filter while backwashing because the pressure differential is in the wrong direction. Kunio never suggested modifying his equipment for filtering while, at the same time, bubbling a column of cleansing gas around the fibers of the skein. Moreover there is nothing in Kunio's teaching to motivate one skilled in the art to filter, and at the same time, bubble a cleansing gas between the fibers without passing pressurized gas inside the fibers. From a practical point of view, backwashing and filtration are entirely separate operations. One only considers backwashing when filtration is no longer satisfactory. No one of ordinary skill in the art considers backwashing while filtering because the pressure drop is in the wrong direction.

Note further that, though there is no teaching by Kunio as to the details of how backwashing is to be carried out, it is reasonable to expect that backwashing Kunio's skein requires using air under relatively high pressure, and that the air is pulsed (typically 5 second pressures) in accordance with a technique described in examples 3 and 4 of U.S. Patent No. 4,767,539 to Ford. In examples 3-10 air at 500 kPa (72.5 psig) is used; and in example 11, air is used at 475 kPa. The high pressure is required to overcome the transmembrane differential so that air being forced

through the pores of the membrane will help dislodge solids adhering to the outer surfaces of the fibers. Kunio obtains additional assistance to shed adhering solids by providing oscillating fibers. Kunio states: "As shown in Figure 2, this is because it is necessary for the hollow yarn 2a to oscillate to a certain extent when bubbling is performed during backwashing, and the solid portion gets shaken off by said oscillation." (see middle of page 6, middle of second full paragraph). The resulting effects of the combination of the foregoing "through-the-fiber" air, coupled with oscillation of the fibers during backwashing, is referred to in the detailed description quoted above, relevant portions of which are italicized.

Concluding his description of the extended length skein, Kunio states three (enumerated 1 to 3) benefits obtained during backwashing his skein, and points out that as a result of the foregoing three benefits, a fourth benefit is that such backwashing allows fibers near the center of the bundle to filter effectively. (see bottom of page 6, and top of page 7).

Kunio then summarizes the "Benefits of the Inventions" as follows:

"As explained in detail above, through the hollow yarn membrane filter resulting from the present invention, there are great benefits in that it is possible to prevent the situation whereby the hollow yarn whirls up and therefore becomes twisted and bent or damaged and to provide effective backwashing."

There can be little doubt that Kunio's only concern was to provide an extended length skein which could survive the backwashing process, as he described it.

Amended claim 13 now specifies a filtration process requiring the distinctive steps of introducing cleansing gas between the fibers, vertically scrubbing the fibers, keeping them clean, and simultaneously (in the final step) withdrawing permeate.

The rejection in paragraph 2 in the Detailed Action of the office action (page 3) of claims 1-14 under the judicially created doctrine of obviousness-type double patenting over claims 1-20 of U.S. Patent No. 5,639,373 is now moot in view of the terminal disclaimer filed herewith.

The rejection in paragraph 3 (it is misnumbered 2) in the Detailed Action (page 4) of claims 1-14 under the judicially created doctrine of obviousness-type

double patenting over claims 1-20 of U.S. Patent No. 5,639,373 in view of Cote et al. U.S. Patent No. 5,248,424 is respectfully traversed. The thrust of the '424 invention is to maintain an **arcuate configuration** of the fibers in the skein so that the fibers would intercept the rising of bubbles of scrubbing gas. Furthermore, the '424 reference could not have suggested the critical "slack" required in a **vertical** skein since it is clear from its disclosure that the arcuate configuration could reasonably expect to require fibers which were substantially longer than 5% more than the distance between the spaced-apart headers. Nor could the '424 reference suggest the flexible support means between adjacent fibers. The primary reference is inapplicable in view of the terminal disclaimer. With respect to combining the references for the purpose of an obvious rejection, there must be some motivation in the references to make the combination suggested. Neither reference alludes to the problem solved by the invention claimed. Therefore the combination fails to provide an effective rejection for obviousness.

With respect to paragraph 4 (misnumbered 3) in the Detailed Action, it is readily conceded that passing gas in a vertical hollow fiber arrangement to clean the membrane, as taught in Cote et al (U.S. Patent No. 5,607,593) is conventional; however, the '593 reference does not suggest the use of critically "slack" fibers to avoid breakage.

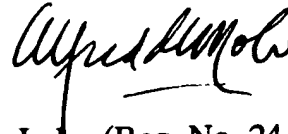
In U.S. Patent No. 5,480,553, Yamamori et al disclose a prior art cylindrical module (in Fig 16) used in their example 1. How their prior art module was constructed is described as follows: "A cylindrical module of the construction illustrated in Fig 16 was fabricated by fixing the ends of porous polyethylene hollow fibers (commercially available outer diameter of 380 μm) with a urethane resin. Each hollow fiber form a loop had a length of 760 mm and a total effective filtering area of the module was 5 m^2 ." If not self-evident from the Fig 16, this description clearly indicates that there is only one header in which both ends of each fiber are potted in a resin so as to form a loop with each fiber. The construction of the article is unrelated to the claimed vertical skein.

In U.S. Patent No. 5,403,479, Smith et al disclose a frameless arrangement of

hollow fibers in spaced-apart headers but provide no suggestion of the problem solved in the invention claimed herein - which problems are specific to a vertical skein used with an aerator so as to simultaneously filter substrate yet maintain the outer surfaces of the fibers clean.

In view of the terminal disclaimer filed herewith, the foregoing remarks, arguments, and amendments to the specification and the claims, it is respectfully submitted that the basis for the rejection has been overcome and that the claims are in condition for allowance.

Respectfully submitted,

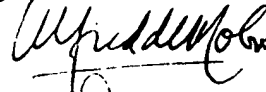


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CERTIFICATE UNDER 35 U.S.C. 1.8(a)

I certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on this 8th day of January 1998.

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Date:

Jan. 8, 1998

Appeal Brief
Appl. No. 09/425,234

RELATED DECISIONS APPENDIX

None